Pakistani Transmission Grid

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Description of data file

Data file named ''ptgm.xlsx'' contains 5 sheets that are also in CSV format. Each sheet contains different columns which are described below.

1. **Nodes sheet / ptgm_nodes.csv**
   This sheet / CSV file contains 10 columns

Column (name)	Description
A (nid)	It contains integer index used within this model to identify each node.
B (osm_id)	OSM ID of the nodes is provided in this column.
C (name)	It contains name of the substation or power plants.
D (type)	It indicates the type (substation or power plant) of the node.
E (lat)	Latitude, geographical position of the node.
F (lon)	Longitude, geographical position of the node.
G (nominal_power_output)	It contains the nominal power output of a power plant in unit Megawatt (MW).
H (population)	The estimated population supplied by corresponding node.
I (fraction_of_population)	Fraction of the total population of Pakistan being supplied by this node.
J (fraction_of_total_consumed_power)	Fraction of the total Pakistani power consumption at this node in unit Watthour (Wh).

2. **Links sheet / ptgm_links.csv**
   This sheet / CSV file contains the list of links (edges) of the graph. The following columns are described

Column (name)	Description
A (lid)	It contains integer index used to identify each link.
B (osm_id)	OSM ID of the link is used in this column.
C (nid1)	The ID of the node where the link stats.
D (nid2)	The ID of the node where the link ends.
E (voltage)	The voltage of the link. In the latest model we consider only 220 kV and 500 kV. Unit: Volts (V).
F (cables)	The number of the cables in the circuit. Typically a multiple of 3 due to 3-phasic AC circuits.
G (wires)	The number of '' wires'' each cable is split into. Note: This

	information is so far missing from OSM data of Pakistan.
H (length_direct)	The direct displacement between start and end node of the link.

3. Cities sheet / ptgm_cities.csv

This sheet / CSV file contains the list of major Pakistani cities. This data has been used to estimate what share of power is consumed by each node in this model by exercising a simple nearest-neighbor search for each city among the set of nodes.

The following column are described

Column (name)	Description
A (cid)	It contains an integer index used within this model to identify each city.
B (name)	The name of cities.
C (population)	Population of the city
D (province)	Name of the state/province in this city is located.
E (lat)	Latitude, geographical position of the city.
F (lon)	Longitude, geographical position of the city.
G (closest_distance)	Distance to the closest node. Unit: Kilometes (km).
H (closest_substation_index)	Index of the closest node.

4. Industries sheet / ptgm_inductries.csv

This sheet / CSV contains list of 100 major Pakistani industries. The columns of the sheet are described below.

Column (name)	Description
A (iid)	It contains an integer index used in this model to identify each industry.
B (name)	Name of the industry.
C (city)	Name of the city in which the industry is located.
D (closest_substation_index)	It contains name of the closest node.

5. State sheet / ptgm_states.csv

This sheet / CSV file contains the list of Pakistani state / provinces. The following columns are described below.

Column (name)	Description
A (sid)	It contains an integer index used in this model to identify each state / province.
B (name)	The Name of the state / province.
C (population)	The number of citizen in this state.

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List of data sources

1. **The OpenStreetMap project (OSM)**
   The OpenStreetMap project, http://www.openstreetmap.org/ . OpenStreetMap data is licensed under the Open Data Commons Open Database License (ODbL), see http://www.openstreetmap.org/copyright for more information. (c) OpenStreetMap contributors. The alternative OSM inferface provided byhttp://www.flosm.de/ has also been used**.**

2. **Google Maps**
   Aerial photography provided by Google Maps has been used to correct and extend the data provided by the OpenStreetMap project, especially for "filling the gaps" in the OSM data. http://www.google.de/maps .

3. **citypopulation.de**
   The list of major Pakistani cities and their population have been taken from http://www.citypopulation.de/Pakistan-20T.html by Thomas Brinkhoff. The data is published under a Creative Commons Attribution 3.0 Unported license (CC BY 3.0).

4. **scribd.com**
   The list of major Pakistani industries has been taken from the book "List of 100 Companies of Pakistan" by Humayun Maqbool (2009), http://www.scribd.com/doc/12487960/List-of-100-Companies-of-akistan . scribd.com is an online publishing network. This book has been published under an "attribution non-commercial" license.

Acknowledgements

Abbreviations

OSM: The OpenStreetMap project, http://www.openstreetmap.org/